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To R. Long	From A. Stomberg	
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April 29, 2002

Mr. Richard Long
U.S. Environmental Protection Agency
Region 8 Air and Radiation Program
999 18th Street, Suite 300
Denver, Colorado, 80202

Via fax: 303-312-6065

Subject: Response to Draft Dispersion Modeling Analysis of PSD Class I Increment Consumption in North Dakota and Eastern Montana

Dear Mr. Long:

The U.S. Environmental Protection Agency (EPA) released a draft dispersion modeling analysis of Prevention of Significant Deterioration (PSD) increment consumption in North Dakota and eastern Montana with a letter dated March 5, 2002. The report, dated January 2002, was entitled *Dispersion Modeling Analysis of PSD Class I Increment Consumption in North Dakota and Eastern Montana.* The March 5, 2002 letter accompanying the EPA document requested comments on the report within 30 days. The comment period was extended through April 29, 2002. Tetra Tech, on behalf of Montana-Dakota Utilities Co. (Montana-Dakota), has conducted a technical evaluation of the EPA draft dispersion modeling analysis.

Tetra Tech has reviewed EPA's report and concluded that the EPA modeling method should not be used at this time. This decision was made based on the following reasons:

- CALPUFF has not been designated as a regulatory-approved model.
- There is evidence that CALPUFF is overpredicting concentrations.
- Several problems have been identified with the emissions inventory. These include:
  - Failure to include increment expanding minor sources
  - Failure to exclude variance emissions
  - Failure to include increment expanding emissions from the Mandan Refinery
  - Inconsistent approach for calculating current and baseline emissions from major sources
  - Failure to follow PSD regulations for determining current and baseline emissions
- Tetra Tech has identified questions about the ability of CALMET, as applied by EPA, to accurately represent upper air data. This is due to several factors, including the sparsity of upper air measurements; the use of coarse grid resolution in both the horizontal and in the vertical; the use of a modified wind extrapolation method; and, in some cases, the use of arbitrary input parameters to CALMET.

- Test model runs indicated that CALPUFF results vary significantly with changing input parameters. Therefore, additional discussion of these parameters is required before conclusions can be drawn based on model runs.

Each of these points is discussed in more detail in the sections below.

Limitations of CALMET/CALPUFF

Although EPA is on a path to promulgate CALPUFF as a guideline model for long-range transport applications, there are a number of implementation issues and model limitations that still need to be addressed. There is relatively little guidance associated with many of the required model inputs, while other site-specific inputs have no default values identified.

EPA proposed CALPUFF as a guideline model for long-range transport applications partly because of recommendations given by the Interagency Workgroup on Air Quality Modeling (IWAQM), which was formed to provide a consistent approach for evaluating impacts in Class I areas. Yet IWAQM indicates that CALPUFF may be expected to overpredict concentrations at distances on the order of 200 kilometers or more. This is described in IWAQM's 1998 report entitled *Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*.

From Section 2.3.2 of the IWAQM Phase 2 report:

> "...it appears that CALPUFF provides reasonable correspondence with observations for transport distances of order 100 kilometers. Most of these comparisons involved concentration values averaged over 5 to 12 hours. The CAPTEX comparisons, which involved comparisons at receptors that were 300 kilometers to 1000 kilometers from the release, suggest that CALPUFF tends to overestimate surface concentrations by a factor of 3 to 4. Use of the puff splitting option in CALPUFF might have improved these comparisons, but there are serious conceptual concerns with the use of puff dispersion at very long-range transport (300 kilometers and beyond). As the puffs enlarge due to dispersion, it becomes problematic to characterize the transport by a single wind vector, as significant wind direction shear may well exist over the puff dimensions."

From Appendix D of the IWAQM Phase 2 report:

> "...The IWAQM concludes that CALPUFF can be recommended as providing unbiased estimates of concentration impacts for transport distances of order 200 kilometers or less, and for transport times of order 12 hours or less. For larger transport times and distances, our experience thus far is that CALPUFF tends to underestimate the horizontal extent of the dispersion and hence tends to overestimate the surface-level concentration maxima. This does not preclude the use of CALPUFF for transport beyond 300 kilometers, but it does suggest that results in such instances be used cautiously and with some understanding."

It appears from the above IWAQM findings that at a distance of 200 kilometers, the CALPUFF modeling

estimates would likely have an overprediction tendency somewhere between the unbiased ratio of 1 at 100 kilometers and the ratio of 3 to 4 at 300 kilometers and beyond. An overprediction tendency at a distance of 200 kilometers of about 2 may be expected.

EPA relies on a model performance evaluation conducted by North Dakota Department of Health (NDDH) to conclude that CALPUFF is performing well in their modeling analysis. However, using EPA's standard model performance criteria, CALPUFF is shown to overpredict concentrations. For example, EPA describes the fractional bias test in the 1992 document, *Protocol For Determining the Best Performing Model*. The fractional bias test is used to determine if a model meets the minimum operational performance standards. In this technique, the top 25 modeled concentrations are compared with the top 25 measured concentrations at a given location. The screening evaluation tests whether the fractional bias of the average and the fractional bias of the standard deviation falls between the ranges of –0.67 to + 0.67. If not, the model is overpredicting or underpredicting by a factor of 2 or more. Figure 1 shows the results of the fractional bias test for 24-hour modeled concentrations at Theodore Roosevelt National Park, South Unit (TRNP SU). Plots of the fractional bias that are near the center of the plot would indicate a model relatively free from bias. Plots showing negative fractional bias are overpredicting, and plots with positive fractional bias are underpredicting. As can be seen in Figure 1, the fractional bias is negative for the TRNP SU case, and indicates a significant overprediction.

Given these limitations and the fact that CALPUFF is not a regulatory-approved model, EPA's use of CALPUFF requires further evaluation.

Emissions Inventory

A number of problems were identified with the emissions inventory used in EPA's modeling. Several of these are discussed in this section.

The Mandan Refinery, which is adjacent to Montana-Dakota's Heskett Station, was not included in the EPA baseline or current source inventory; however, it is less than 250 kilometers from the Class I areas in question. Facility-wide emissions at the Mandan Refinery would likely be applicable to this study since the refinery is within the 250-kilometer radius specified by NDDH for including major source emissions. The refinery existed during the baseline date, and still exists today. Emissions for Units 1 through 4 at the Mandan refinery are increment expanding. Emissions from Unit 5 at the Mandan Refinery are increment consuming.

The emission inventory used for the modeling excluded all minor sources. Most of the minor sources surrounding the Class I areas are oil and gas facilities. Since the North Dakota minor source baseline year, the practice of flaring has decreased at these facilities and SO_2 emissions have subsequently decreased. The decrease in SO_2 emissions results in PSD increment expansion within the impact area of these oil and gas facilities.

Because the oil and gas facilities are relatively close to the North Dakota Class I areas, and because there are so many of them, a significant impact on the Class I areas is possible. EPA's modeling report indicates that these sources will be incorporated into the final modeling analysis. However, the results of the EPA modeling analysis completed in January 2002 cannot be considered valid without the inclusion of minor source emissions.

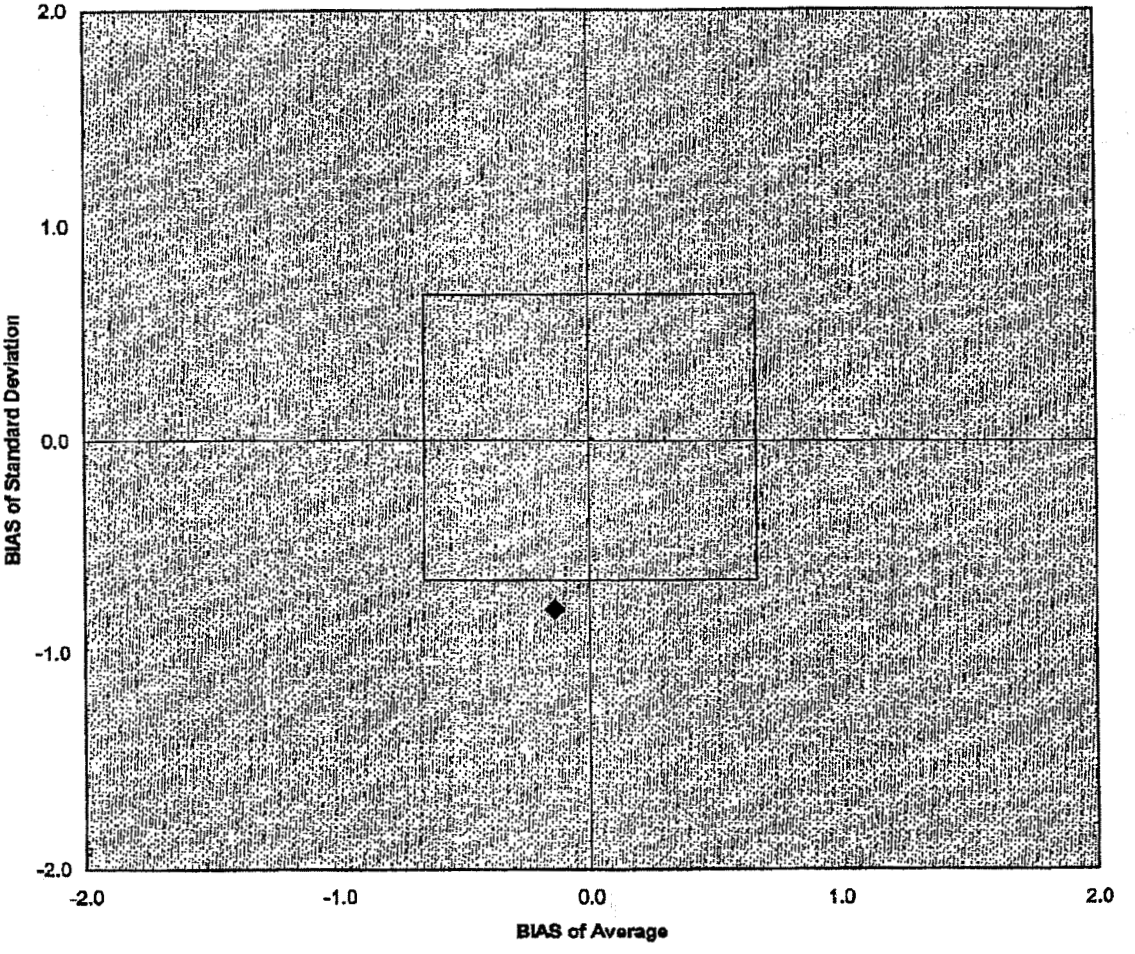
Meteorological Data

A review of the meteorological data used in the modeling analysis reveals that there may be several problems with the data itself, and the method of processing the data within CALMET. The problems

identified with the meteorological data could have a significant effect on EPA's modeled concentrations presented in the report.

The lack of upper air data between Bismarck and the Class I areas calls into question the estimated wind fields in this region where most of the plume transport to the Class I areas takes place in the modeling study. Data processing techniques that used subjective BIAS parameters, coarse horizontal and vertical

Figure 1
Fractional Bias, 2000 24-hour SO2 Concentrations
Theodore Roosevelt National Park, South Unit



grid resolution, and a modified method for extrapolating surface winds to upper levels all result in questionable processed meteorological data.

Some possible methods for improving the meteorological data may be to incorporate MM4 or MM5 solutions into the CALMET processing, collecting additional upper-air data within the plume transport region, use of smaller horizontal grid spacing, and increasing the number of levels in the vertical, particularly in the vertical zone occupied by the puffs.

CALPUFF Tests

CALPUFF was tested to determine the effect of changing input parameters on model results. It was determined that model input changes for key variables can significantly change model results. Questionable data and data processing inputs such as meteorological data processing (discussed above), and model algorithm options should be completely understood before critical decisions are made based on the model results.

The above discussion summarizes some of Montana-Dakota's concerns with EPA's CALPUFF Class I modeling analysis, and why it should not be used for determining PSD increment consumption in the Class I areas. The Montana-Dakota team appreciates the opportunity to comment on EPA's document.

Sincerely,

Andrea Stomberg

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A Stomberg for Robert Hammer

Robert J. Hammer
Tetra Tech